

NUTRIENT CONCENTRATIONS IN STREAMS ENTERING THE DELAWARE WATER GAP NATIONAL RECREATION AREA, PENNSYLVANIA AND NEW JERSEY

Jeffrey M. Fischer¹, R. Edward Hickman¹, and Allan Ambler²

¹ U.S. Geological Survey, West Trenton, N.J.

² National Park Service, Milford, Pa.

Delaware Water Gap National Recreation Area



- Almost 70,000 acres along a 40 mile river corridor
- Over 4 million visitors per year
- Activities - canoe, hike, camp, swim, picnic, bicycle, crosscountry ski, and horseback ride.

Problem

- Development outside the park has the potential to affect stream-water quality
- Park and Delaware River Basin Commission have anti-degradation regulations
- Existing water quality needs to be defined so park can enforce standards

Study Objective

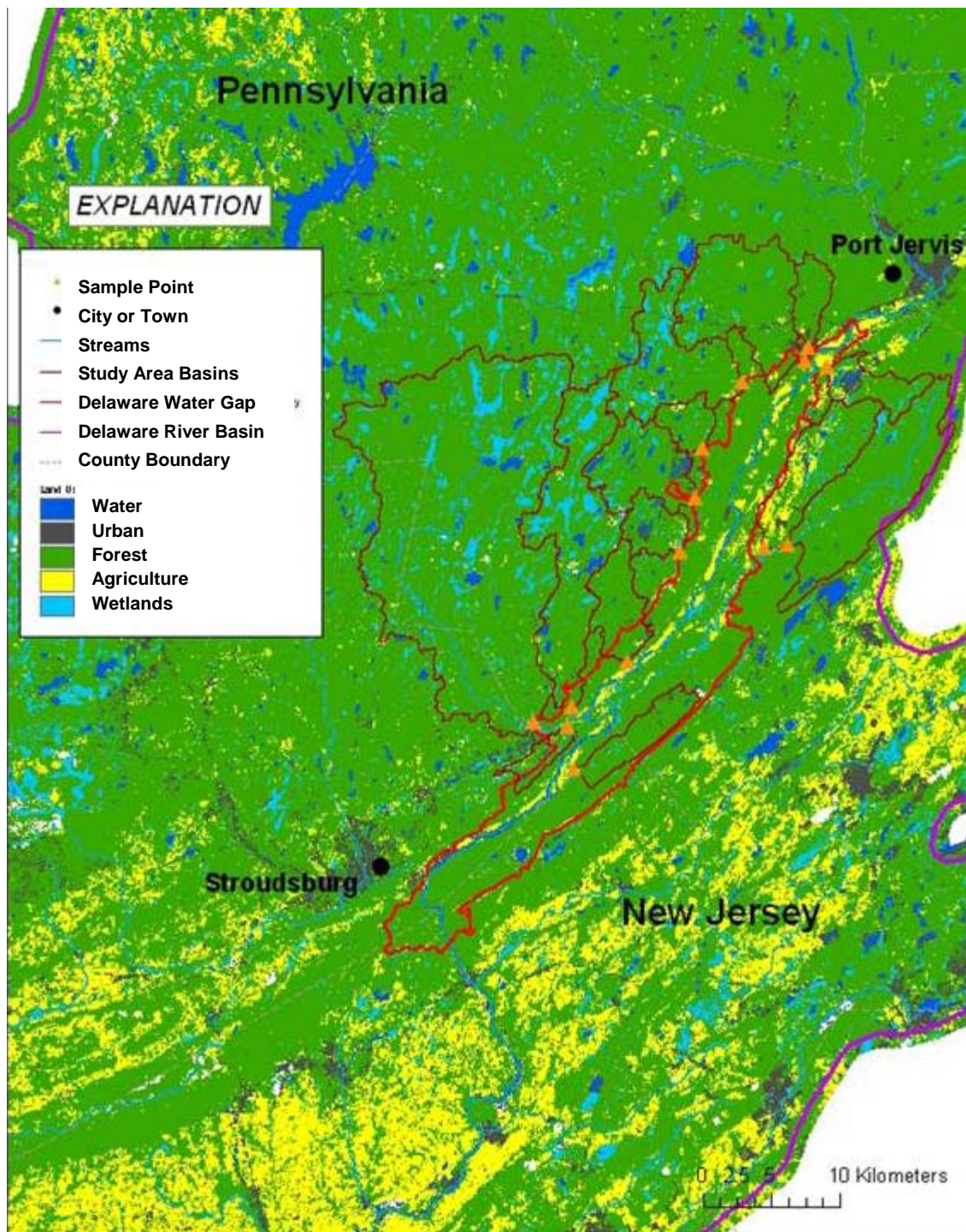
- Define existing nutrient concentrations in streams entering the park

Related Objectives:

- Sample other constituents
- Relate water quality to land use
- Calculate nutrient loads for different sources

Additional Sources of Support

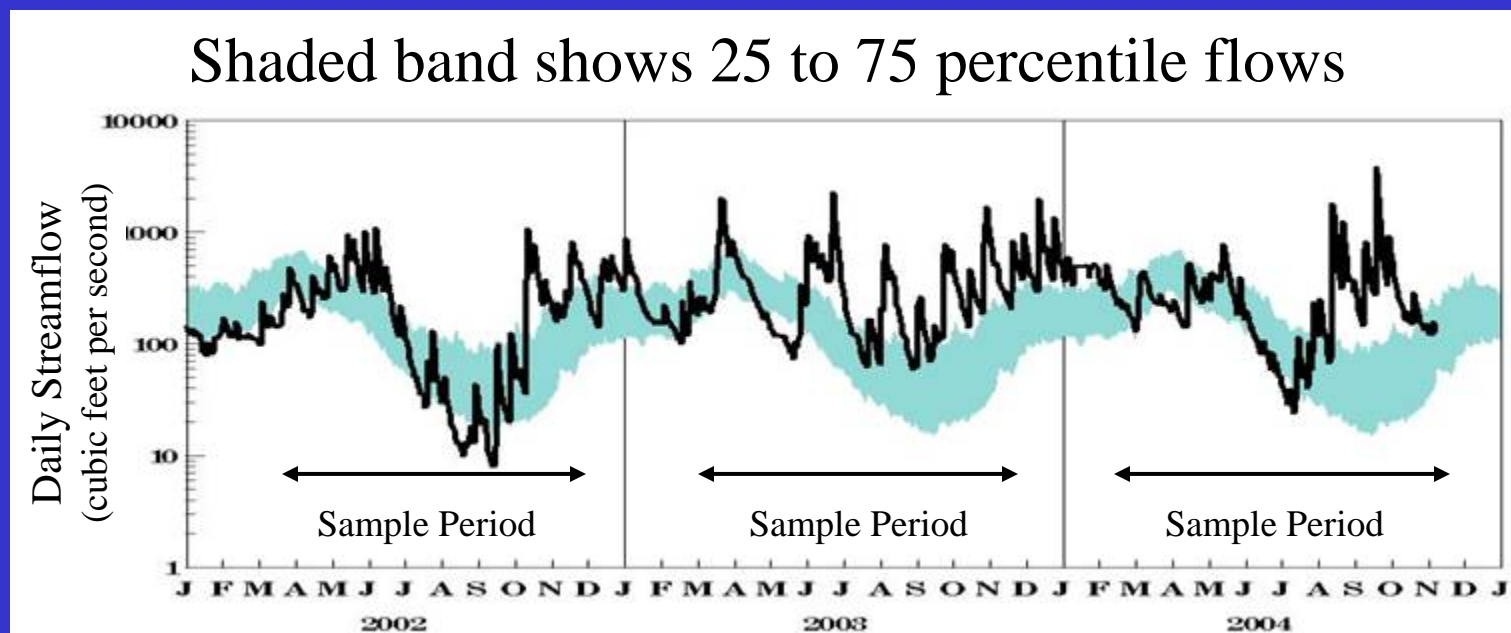
- Study funded through NPS/USGS Water Quality Assessment and Monitoring Partnership Program
- Additional NPS funding for Interns
- USDA Forest Service Forest Health and Management - Land-use characterization
- USGS National Water Quality Assessment Program – water quality, stream ecology, and stream loads



Study Area

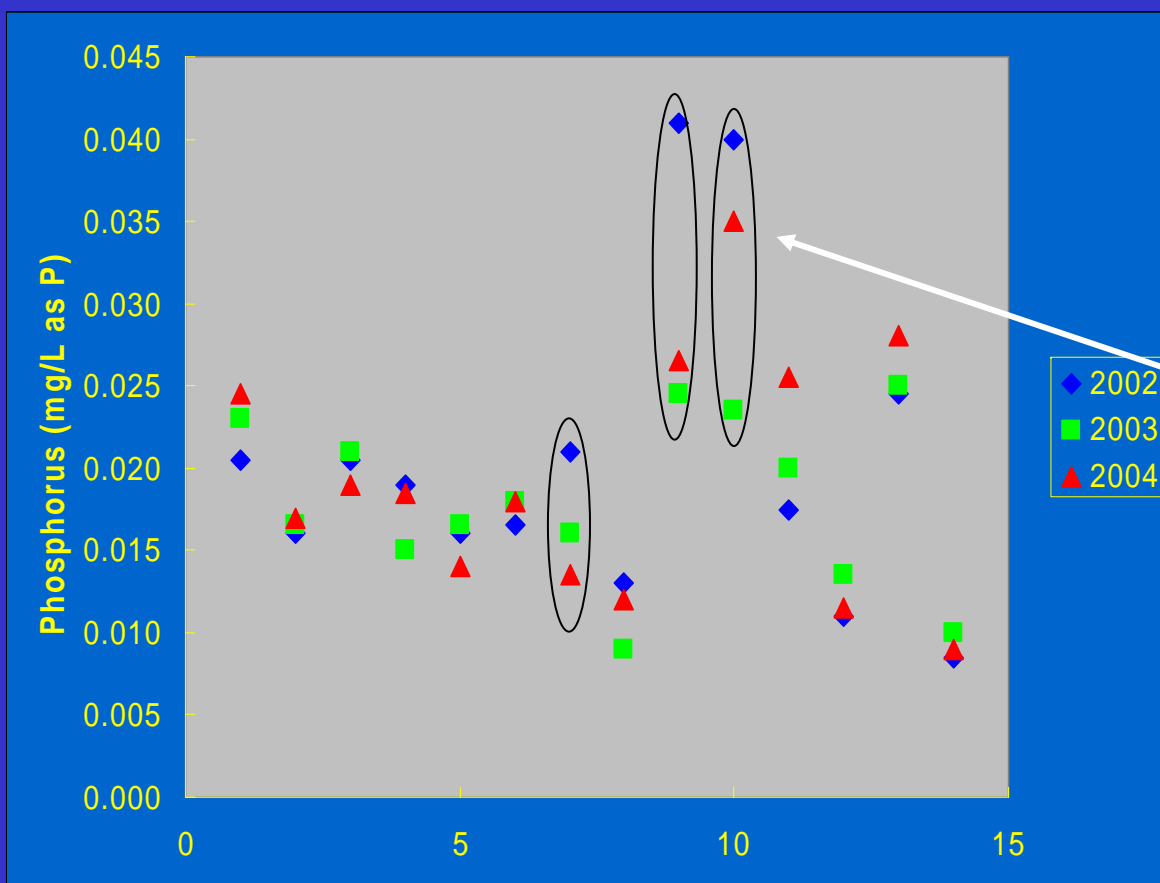
- 14 Boundary-Point Streams Sampled
- Sampled from April through November in 2002, 2003, & 2004
- biweekly to monthly sampling
- Some storm samples
- Basins 5 to 30 mile² (one >100)

Streamflow During Study Period



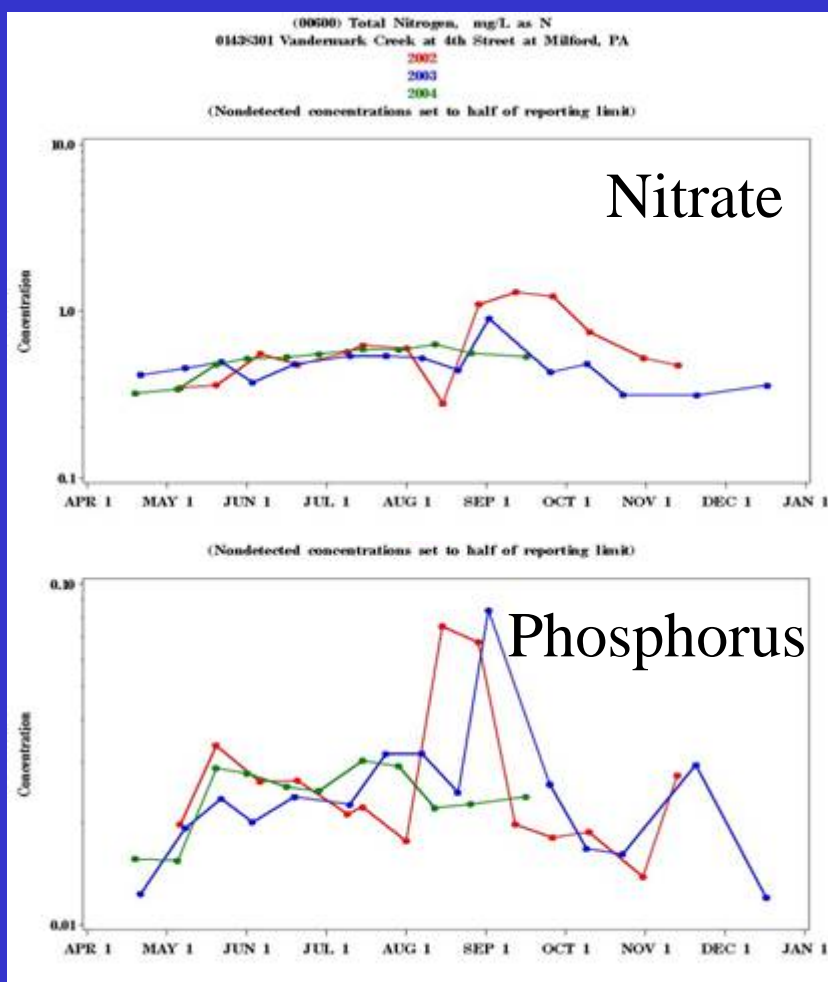
- Streamflow was slightly below normal in 2002
- 2003 & 2004 were wetter years

Yearly Differences in Nutrients



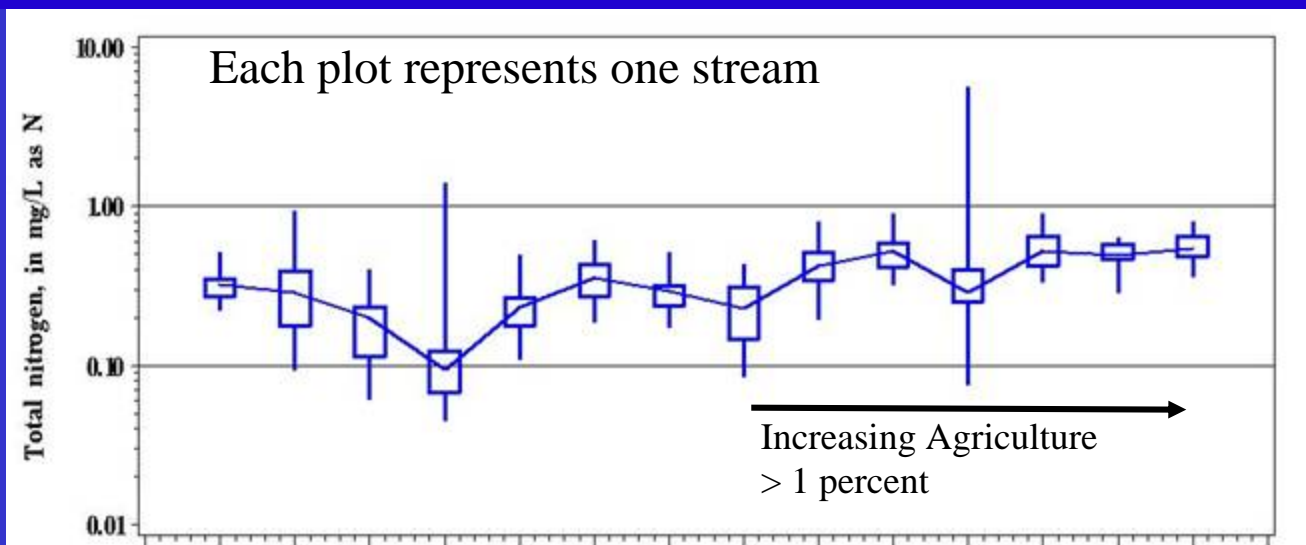
- Most sites showed little seasonal variation
- Developed sites had higher concentrations in 2002 (low-flow year)

Seasonal Variations



- Changes likely due to seasonal influx of residents using septic systems
- Phosphorus limits biochemical reactions in streams

Total Nitrogen Distribution

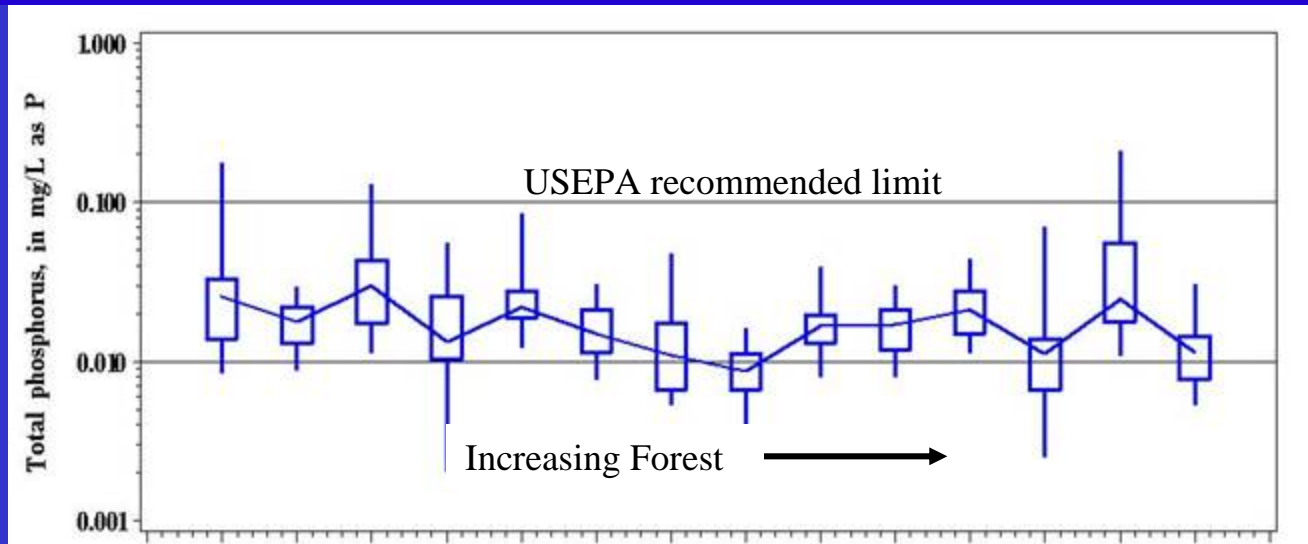


- Normally less than 1.0 mg/l as N
- Hard to relate differences to land use

BOX PLOTS

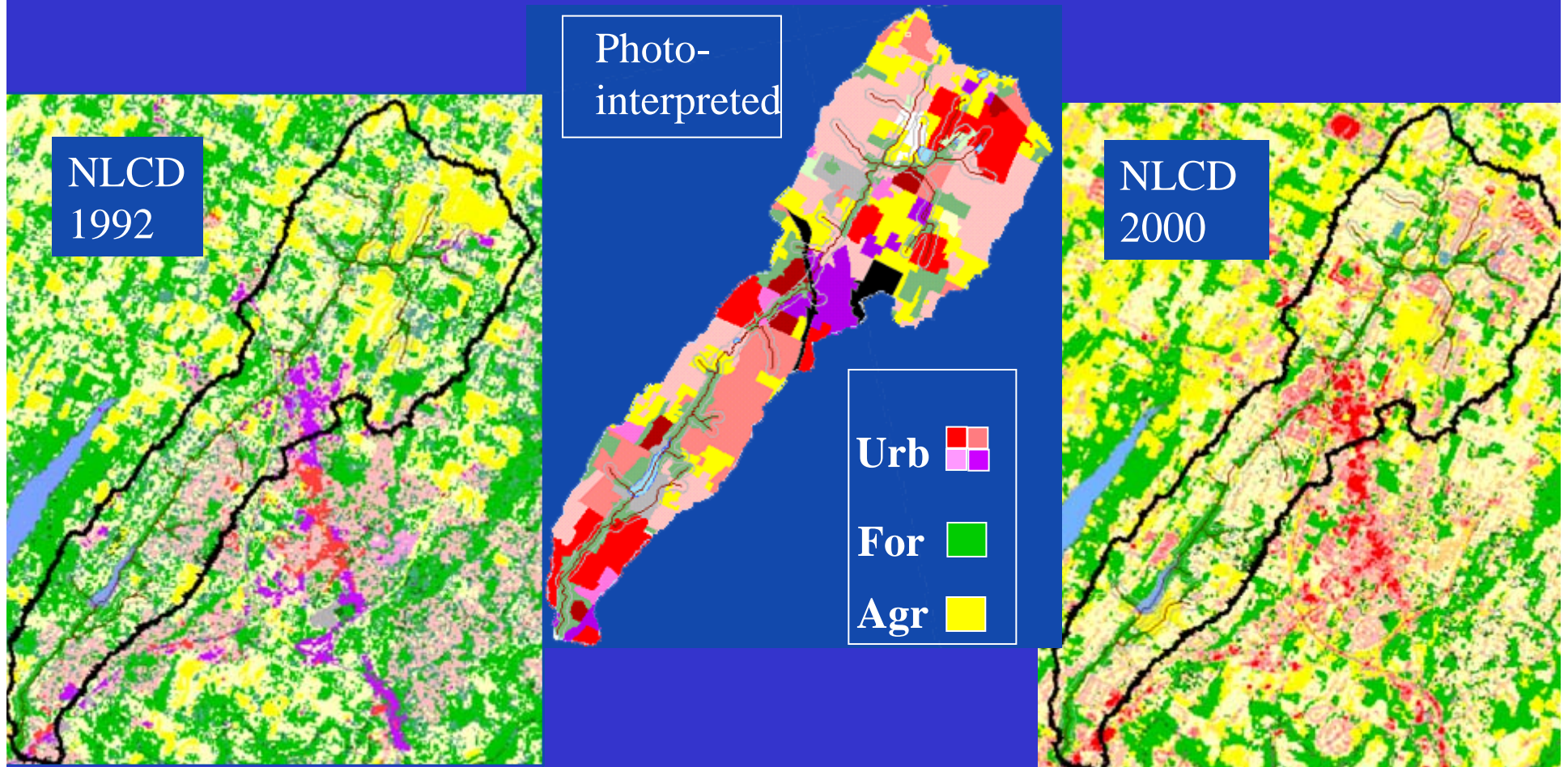
Maximum -- top line
 75th percentile -- top of box
 Median -- middle of box
 25th percentile -- bottom of box
 Minimum -- bottom line

Total Phosphorus Distribution



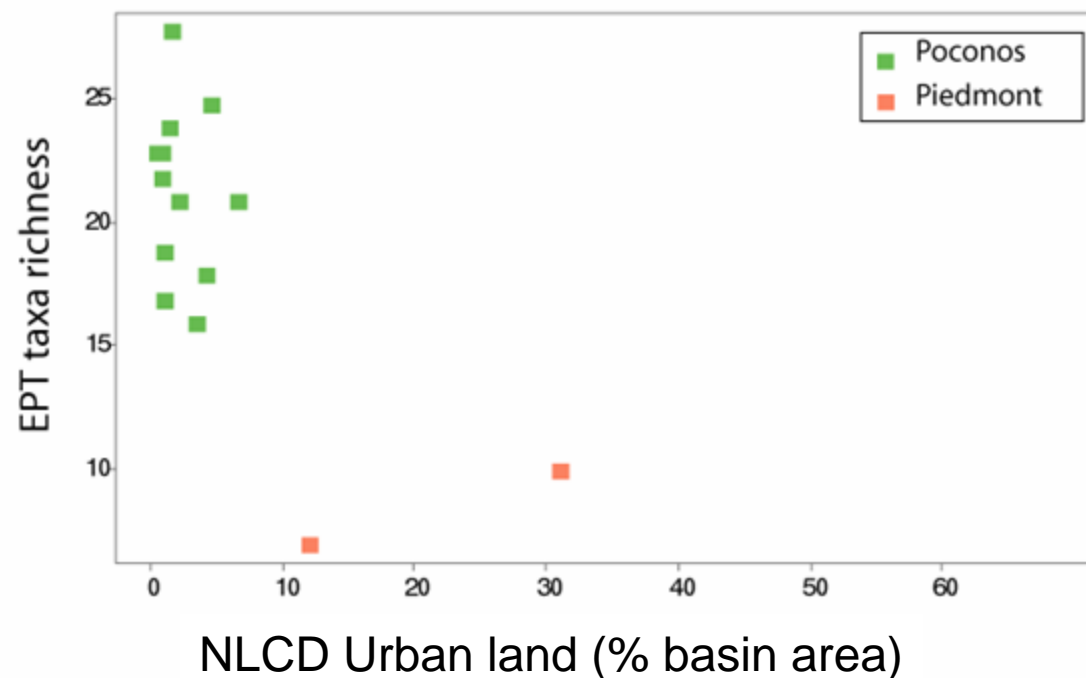
- Normally less than USEPA recommended limit
- Little relation to land use
- Point sources important

Common problem: Landscape data issues (Timeliness, accuracy, detail, availability)



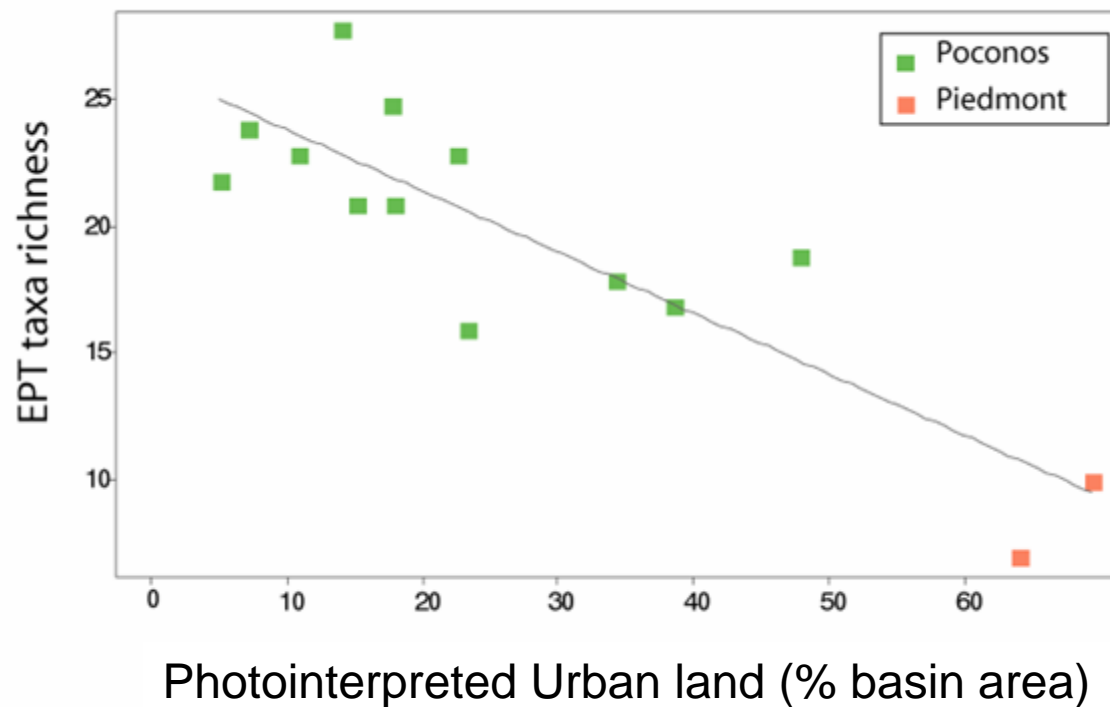
NLCD = National Land Cover Data

Analyses with photo-interpreted land-use data produced completely different results from analyses conducted with National Land Cover Data (NLCD).



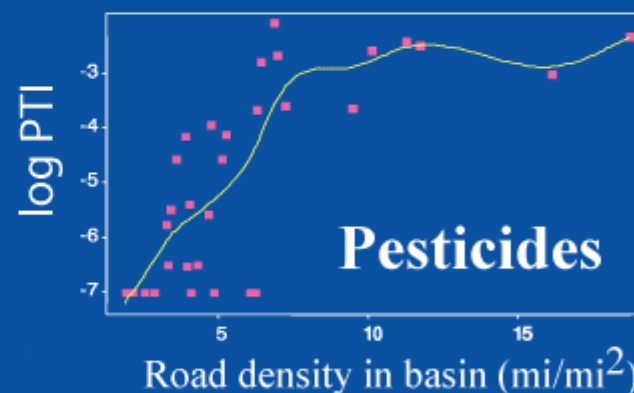
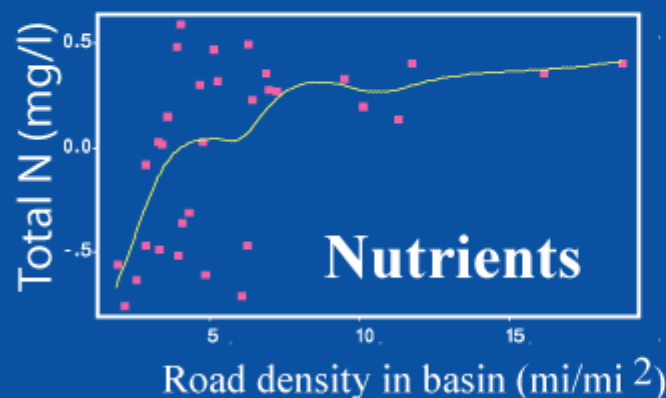
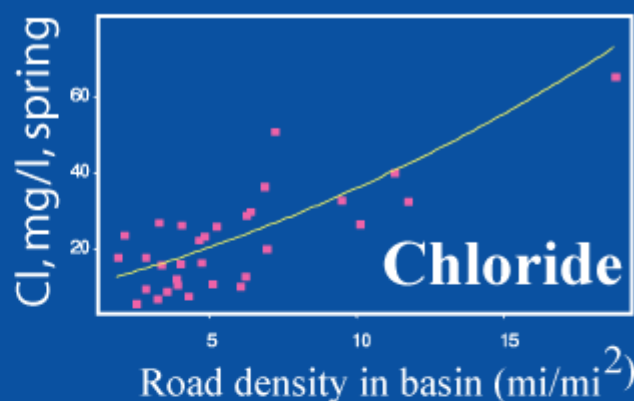
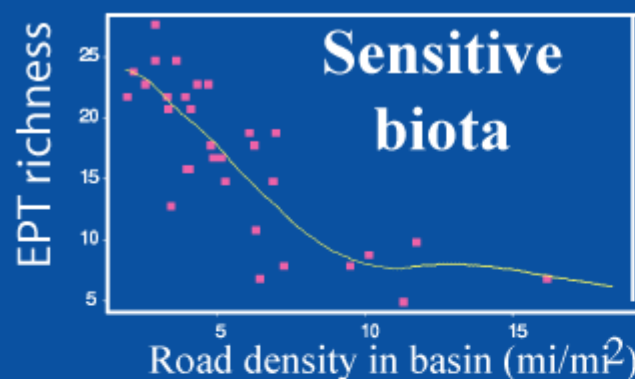
No biological response is seen in the Poconos (Delaware Water Gap NRA) using NLCD data.

Example of biological response to urbanization – using photointerpreted data



Sensitive invertebrate taxa are lost as urbanization progresses in Poconos and Piedmont.

Other Water Quality Responses



NOTE: Road density is used as a surrogate for urbanization



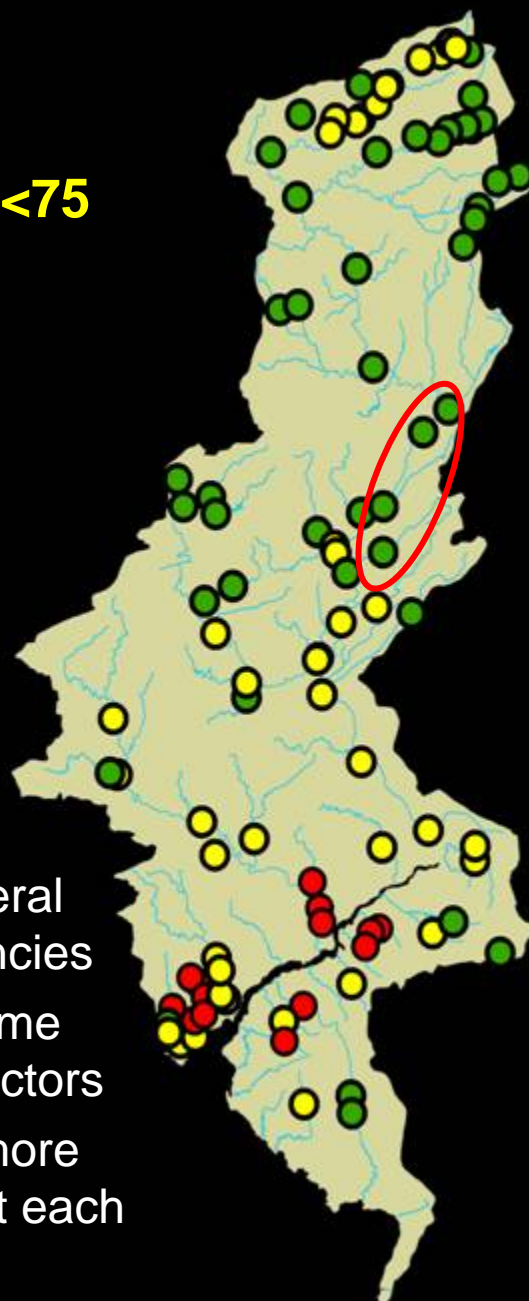
2000 Total Phosphorus Yields

- 109 sites
- 50% are less than 25 kg/km²
- 10 % are greater than 75 kg/km²

Kg/Km²

- ≥ 75
- >25 and <75
- ≤ 25

Major Stream



- Data from Federal and State Agencies
- 1975 to 2000 time period for predictors
- Usually 10 or more years of data at each site



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